RESEARCH REPORT
(for RTOPs and Grants)

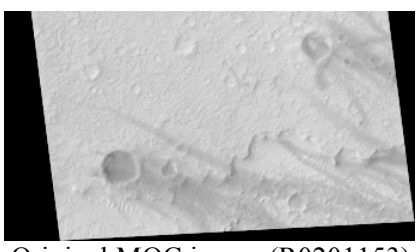
1. Title Detecting Transient Surface Features with Dynamic Landmarking		**2. Date Prepared** 09 29 2008
3. Performing Organization: Jet Propulsion Laboratory		**4. RTOP/Grant No.**
4.A. JPL Project Number: **102294-982745.03.14**	**(Per GSK Policy, this serves as the Work Authorization Document)**	**4.C. NASA WBS NUMBER** **982745.02.02.03.14**
5. Investigator Kiri Wagstaff **Telephone** 818-393-6393	**6. NASA Program Manager** **Joseph Bredekamp**	**7. NASA Division** Science Mission Directorate
8. Reference **NRA Number: NNH07ZDA001N-AISR Other:**		

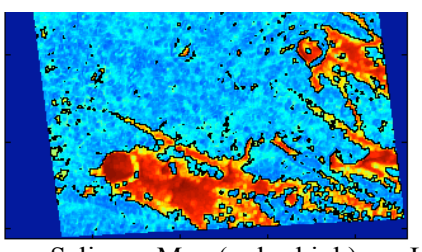
9. Funding Profile:	**FY'08 Prior Approvals**	**FY'09 Current Guideline**	**FY'09 Current Request**	**FY'09 Current Overguide**	**FY'10 Next Request**
	$ 220.1 K	$ 225.3 K	$ 225.3 K	$ 0 K	$ 230.1 K

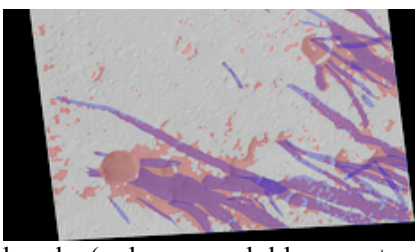
10. Description

FY'08 Technical Accomplishments:

1. Demonstrated 90% detection rate for dark slope streaks and 80% detection rate for dust devil tracks in MOC imagery using KL-divergence salience estimation and square windows to model landmarks (April 2008).
2. Hired Julian Panetta, a junior at the California Institute of Technology, for a summer internship (June – August, 2008). Many of the following accomplishments are the results of his hard work.
3. Converted implementation from MATLAB to C and got orders of magnitude speedups (June 2008).
4. Developed a salience map representation that permits the identification of landmark contours directly, rather than using square windows to model landmarks (June 2008).
5. Implemented three more salience estimation methods: two are based on KL-divergence and one is based on entropy (July 2008).
6. Implemented methods to compute landmark features, including area, the mean intensity, and the standard deviation of intensity (August 2008).
7. Demonstrated 95% accuracy in automatically classifying two landmark types (dark slope streaks and dust devil tracks) and 93% accuracy when three types were given (dark slope streaks, dust devil tracks, and craters) (August 2008).


Original MOC image (R0201153)


Salience Map (red = high)


Landmarks (red = manual, blue = automated)

FY'08 Travel and Presentations:

1. Presented a poster at the 2007 Fall Meeting of the American Geophysical Union: "Surface Change Detection from Mars Orbital Imagery." Baback Moghaddam, Brian D. Bue, Rebecca Castano, and Kiri L. Wagstaff (December, 2007).
2. Presented project status and accomplishments at AISR PI meeting (May, 2008).
3. Attended the 2008 Conference on Artificial Intelligence in Chicago, IL (July 13-17, 2008), co-chaired the AI Education Colloquium, and served as a mentor for the AAAI Doctoral Consortium.
4. Held an annual project meeting at JPL on August 22, 2008. All co-investigators attended, including Adnan Ansar (JPL), Ron Greeley (Arizona State University), and Norbert Schorghofer (University of Hawaii).

FY'09 Plans:

1. Submit abstract describing landmark detection and classification results to the 2008 Fall Meeting of the American Geophysical Union.
2. Submit a long paper on these methods to the Remote Sensing of Environment journal.
3. Implement method for computing Regional Landmark Graphs and generate these graphs for MOC images. Evaluate the system's ability to recognize the same region in new images, using subgraph matching techniques, on 100 MOC image pairs.
4. Demonstrate the ability to reliably detect changed landmarks in 200 MOC image pairs, by detecting landmarks in the two images and then identifying any new, vanished, or altered landmarks. Compare speed and accuracy of the detections to state of the art pixel-based registration and change detection methods.

Approval:	**Date:**	**Concurrence:**	**Date:**